DirectñWeighing CorrosionñResistant HighñTemperature Isochoric PVT Apparatus

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A new apparatus is described for high accuracy PVT measurements of ammonia + water and other corrosive mixtures at high temperatures up to 1000 K. The materials of construction were selected from Inconel and stainless steels to provide both high strength and maximum corrosion resistance. The lightweight PVT cell is a welded spherical chamber of approximately 70 cm^3 internal volume. The entire cell assembly is removable for inspection, cleaning, and filling with different samples. The volume occupied by the sample was determined by weighing the doubly-distilled water needed to fill it completely. Temperatures and temperature gradients are measured with a combination of a standard platinum resistance thermometer and chromel-alumel thermocouples. Pressures are measured with a calibrated oscillating quartz crystal pressure transducer mounted in an external temperature-controlled zone of the furnace. The entire apparatus is housed in a copper tempering cylinder that snugly fits into a high-temperature tubular furnace. The amount of sample is measured directly by difference weighings of the PVT cell on a precision microbalance, before and after charging. An assessment of the measurement uncertainties leads to an expanded relative uncertainty (coverage facto, k=2) of the density that is estimated to be 0.03 %. Steam was used to performance test this apparatus over the temperature range of 600 K to 1000 K. The suitability of steam for performance testing is due to the availability of both high accuracy density measurements and the internationally accepted standard reference equation of state (IAPWS-95 formulation) for water and steam.